CLAIMS:

1.   An encoding apparatus for multi-dimensionally encoding a user data stream of user data into a channel data stream comprising:

-       a first modulation code encoding unit (23) having a high code-rate for modulation code encoding said user data (DI) into first modulation data (BS1),

-       an ECC encoding unit (1) for ECC encoding said first modulation data (BS1) obtaining ECC parity data (P),

-       a second modulation code encoding unit (24) having a lower code-rate than said first modulation code encoding unit (23) for modulation code encoding said parity data (P) into second modulation data (BS2),

-       a modulation data combination unit for combining said first and second modulation data (BS1, BS2) into said channel data stream (BS3) comprising at least two bit rows one-dimensionally evolving along a first direction and being aligned with each other along at least a second direction, wherein said first and second modulation data (BS1, BS2) are arranged according to a predetermined order, in particular alternately arranged, in said second direction.

2.   An encoding apparatus as claimed in claim 1,
further comprising a user data separation unit for separating said user data (DI) into first and second user data (DI1, DI2),
wherein:

-       said first modulation code encoding unit (23) is adapted for modulation code encoding said first user data (DI1) into said first modulation data (BS1),

-       said ECC encoding unit (1) is adapted for ECC encoding said first modulation data (BS1) and said second user data (DI2) obtaining said ECC parity data (P), and

-       said second modulation code encoding unit (24) is adapted for modulation code encoding said second user data (DI2) and said parity data (P) into said second modulation data (BS2).

3.   An encoding apparatus as claimed in claim 1,

wherein said apparatus is adapted for two-dimensionally encoding said user data of said user data stream into said channel data stream along a two-dimensional channel strip of at least two bit rows one-dimensionally evolving along a first direction and being aligned with each other along a second direction, said two directions constituting a two-dimensional lattice of
5   bit positions.

4.   An encoding apparatus as claimed in claim 3,
wherein said two directions constitute a two-dimensional hexagonal or square lattice of bit positions.
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5.   An encoding apparatus as claimed in claim 3,
wherein said first modulation data (BS1) are arranged along a first type of two-dimensional modulation strip (SS11, SS12, SS13) of at least two bit rows, in particular of three bit rows, one-dimensionally evolving along said first direction and being aligned with each other along
15   said second direction.

6.   An encoding apparatus as claimed in claim 3,
wherein said second modulation data (BS2) are arranged along a second type of modulation strip (SS11, SS12) of at least one bit row one-dimensionally evolving along said first
20   direction.

7.   An encoding apparatus as claimed in claim 5 and 6,
wherein said modulation data combination unit is adapted for alternately combining said first and second modulation data (BS1, BS2) to obtain a channel data stream (BS3) comprising
25   three first type modulation strips (SS11, SS12, SS13) each having three bit rows and two second type modulation strips (SS21, SS22) each having one bit row arranged between said three first type modulation strips (SS11, SS12, SS13).

8.   An encoding apparatus as claimed in claim 3,
30   wherein said first modulation code encoding unit (23) is adapted for using long codewords, in particular for encoding 152 user bits of said first user data into 153 modulation bits of said first modulation data, in particular using enumerative channel coding.

9.   An encoding apparatus as claimed in claim 3,

wherein said second modulation code encoding unit (24) is adapted for using short codewords, in particular for encoding 12 user bits of said second user data and said ECC parity data into 13 modulation bits of said second modulation data.

5   10.   An encoding apparatus as claimed in claim 1,
wherein said second modulation code encoding unit (24) is adapted for modulation code encoding in such a way that code constraints of said first modulation code are fulfilled when said first and second modulation data (BS1, BS2) are alternately arranged in said channel data stream (BS3).

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11.   A decoding apparatus for multi-dimensionally decoding a channel data stream of channel data into a user data stream, said channel data stream comprising at least two bit rows one-dimensionally evolving along a first direction and being aligned with each other along at least a second direction, wherein said first and second modulation data (BS1, BS2)

15   are arranged according to a predetermined order, in particular alternately arranged, in said second direction, comprising:
-        a channel data separation unit for separating said channel data (BS3') into first and second channel data (BS1', BS2'),
-        a second modulation code decoding unit (64) having a low code-rate for

20   modulation code decoding said second channel data (BS2') into ECC parity data (P'),
-        an ECC decoding unit (7) for ECC decoding said first channel data (BS1') and said ECC parity data (P') obtaining ECC decoded first channel data (BS1''),
-        a first modulation code decoding unit (63) having a higher code-rate than said second modulation code decoding unit (64) for modulation code decoding said ECC decoded

25   first channel data (BS1'') into ECC decoded user data (DO) forming said user data stream.

12.   A decoding apparatus as claimed in claim 11,
wherein:
-        said second modulation code decoding unit (64) is adapted for modulation

30   code decoding said second channel data (BS2') into second demodulation data (DO2') and ECC parity data (P'),
-        said ECC decoding unit (7) is adapted for ECC decoding said first channel data (BS1'), said second demodulation data (DO2') and said ECC parity data (P') obtaining ECC decoded first channel data (BS1'') and ECC decoded second user data (DO2''),

- said first modulation code decoding unit (63) is adapted for modulation code decoding said ECC decoded first channel data (BS1'') into ECC decoded first user data (DO1''), and

- a user data combination unit is provided for combining said ECC decoded first
5   and second user data (DO1'', DO2'') into said user data stream (DO).

13.   An encoding method for multi-dimensionally encoding a user data stream of user data into a channel data stream comprising:

- a first modulation code encoding step having a high code-rate for modulation
10   code encoding said user data (DI1) into first modulation data (BS1),

- an ECC encoding step for ECC encoding said first modulation data (BS1) obtaining ECC parity data (P),

- a second modulation code encoding step having a lower code-rate than said first modulation code encoding step for modulation code encoding said parity data (P) into
15   second modulation data (BS2),

- a modulation data combination step for combining said first and second modulation data (BS1, BS2) into said channel data stream (BS3) comprising at least two bit rows one-dimensionally evolving along a first direction and being aligned with each other along at least a second direction, wherein said first and second modulation data (BS1, BS2)
20   are arranged according to a predetermined order, in particular alternately arranged, in said second direction.

14.   A decoding method for multi-dimensionally decoding a channel data stream of channel data into a user data stream, said channel data stream comprising at least two bit
25   rows one-dimensionally evolving along a first direction and being aligned with each other along at least a second direction, wherein said first and second modulation data (BS1, BS2) are arranged according to a predetermined order, in particular alternately arranged, in said second direction, comprising:

- a channel data separation step for separating said channel data (BS3') into first
30   and second channel data (BS1', BS2'),

- a second modulation code decoding step having a low code-rate for modulation code decoding said second channel data (BS2') into ECC parity data (P'),

- an ECC decoding step for ECC decoding said first channel data (BS1') and said ECC parity data (P') obtaining ECC decoded first channel data (BS1'') and ECC

decoded user data (DO2''),

- a first modulation code decoding step having a higher code-rate than said second modulation code decoding step for modulation code decoding said ECC decoded first channel data (BS1'') into ECC decoded user data (DO1'') forming said user data stream

5   (DO).

15.   A signal comprising channel data of a channel data stream multi-dimensionally encoded from user data of a user data stream, said signal comprising first and second modulation data (BS1, BS2) combined into said channel data stream comprising at

10   least two bit rows one-dimensionally evolving along a first direction and being aligned with each other along at least a second direction, wherein said first and second modulation data (BS1, BS2) are arranged according to a predetermined order, in particular alternately arranged, in said second direction, wherein:

- said first modulation data being modulation code encoded by a first

15   modulation code encoding unit (23) having a high code-rate from user data (DI1), and

- said second modulation data being modulation code encoded by a second modulation code encoding unit (24) having a lower code-rate than said first modulation code encoding unit (24) from parity data (P), said parity data being obtained by ECC encoding said first modulation data (BS1).

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16.   A signal as claimed in claim 15,
wherein:

- said first modulation data being modulation code encoded from first user data (DI1), and

25   - said second modulation data being modulation code encoded from second user data (DI2) and parity data (P), said parity data being obtained by ECC encoding said first modulation data (BS1) and said second user data (DI2).

17.   Storage medium storing a signal as claimed in claim 15.

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18.   Computer program comprising program code means for causing a computer to implement the steps of the method of claim 13 or 14 when said program is run on a computer.